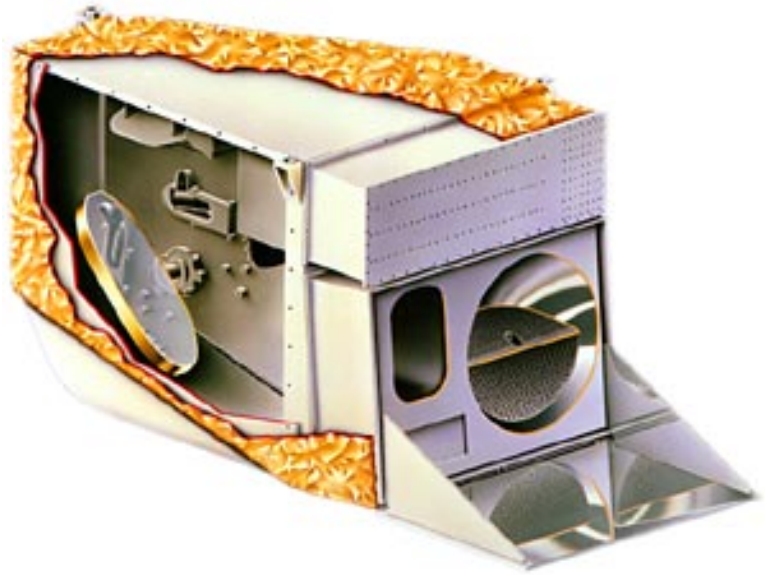
Outline of Validation Charts

MODerate-resolution Imaging Spectroradiometer (MODIS)

- NASA, EOS AM & PM series
  - launches 1999, 2000
  - 705 km polar orbits, alternating descending & ascending (10:30 a.m. & 1:30 p.m.)
- Sensor Characteristics
  - 36 spectral bands ranging from 0.41 to 14.385 μm
  - cross-track scan mirror with 2,330 km swath width
  - Spatial resolutions:
    - » 250 m (bands 1 - 2)
    - » 500 m (bands 3 - 7)
    - » 1000 m (bands 8 - 36)
  - 2% reflectance calibration accuracy
  - onboard solar diffuser & SDSM



MODIS Land Product Suites

Surface Radiation and Energy Budget Products

- Surface Spectral Bidirectional Reflectances Corrected for Atmosphere
- Bidirectional Reflectance Distribution Function (BRDF)
- Albedo
- Land Surface Temperature (day & night)
- Snow and Ice

Ecosystem Characterization Products

- Spectral Vegetation Indices
- Fraction Absorbed Photosynthetically-Active Radiation (fAPAR)
- Leaf Area Index (LAI)
- Net Primary Production (NPP)

Land Cover Products

- Land Cover
- Land Cover Change
- Fire, Thermal Anomalies
- Burn Scars

MODLAND Validation Approach

- **Commitment to the EOS Land Validation Core Sites**
- **Product-specific sites, activities and validation protocols**

  (primarily by MODLAND PIs)
- **Close cooperation with EOS Land Validation and NASA R&A Program Investigators**
- **Establishing interaction with other AM instrument teams and international instruments**

  (GLI, ATSR, MERIS)
- **Interaction with established data networks**

  (e.g. FLUXNET, AERONET)
- **International leverage and coordination and resource sharing**

  (CEOS Cal./Val., TOPC, ILTER, SAFARI 2000, GOFC)

MODLAND Validation Approach (cont.)

- **Participation in community field campaigns (LBA, SAFARI 2000, GCIP)**
- **Developing new validation instrumentation (e.g. MQUALs, CIMEL with BRDF)**
- **Collaboration with the data providers (PI's, DAACs, ESIPS, CRESS)**

Validation Details:

http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL

MODIS Validation site hierarchy

1. EOS Land Validation Core Sites

Serving as a focus for satellite, aircraft, and ground data collection of land product validation, from which scientists can readily access in-situ and EOS instrument data

2. Product Specific Sites

Complementing the core sites, meeting the specific needs of individual MODIS products. Where possible, shared data with other instrument teams with similar products (e.g. Land Surface Temp. with ASTER team)

Core Site Goals:

- **Provide focused, cost effective opportunities for validating EOS Land Products**
- **Increase synergy within and between science teams for data collection and subsequent research**
- **Address science questions as appropriate**
- **Include Earth science networks in validation activities to provide *and* utilize EOS data.**

  (Eventually other sites belonging to these networks can be used to ramp-up validation efforts, leveraging off of the infrastructure and protocols developed through the work done at initial core sites.)

http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL/core_sites.html

Validation Test Sites Selection Criteria

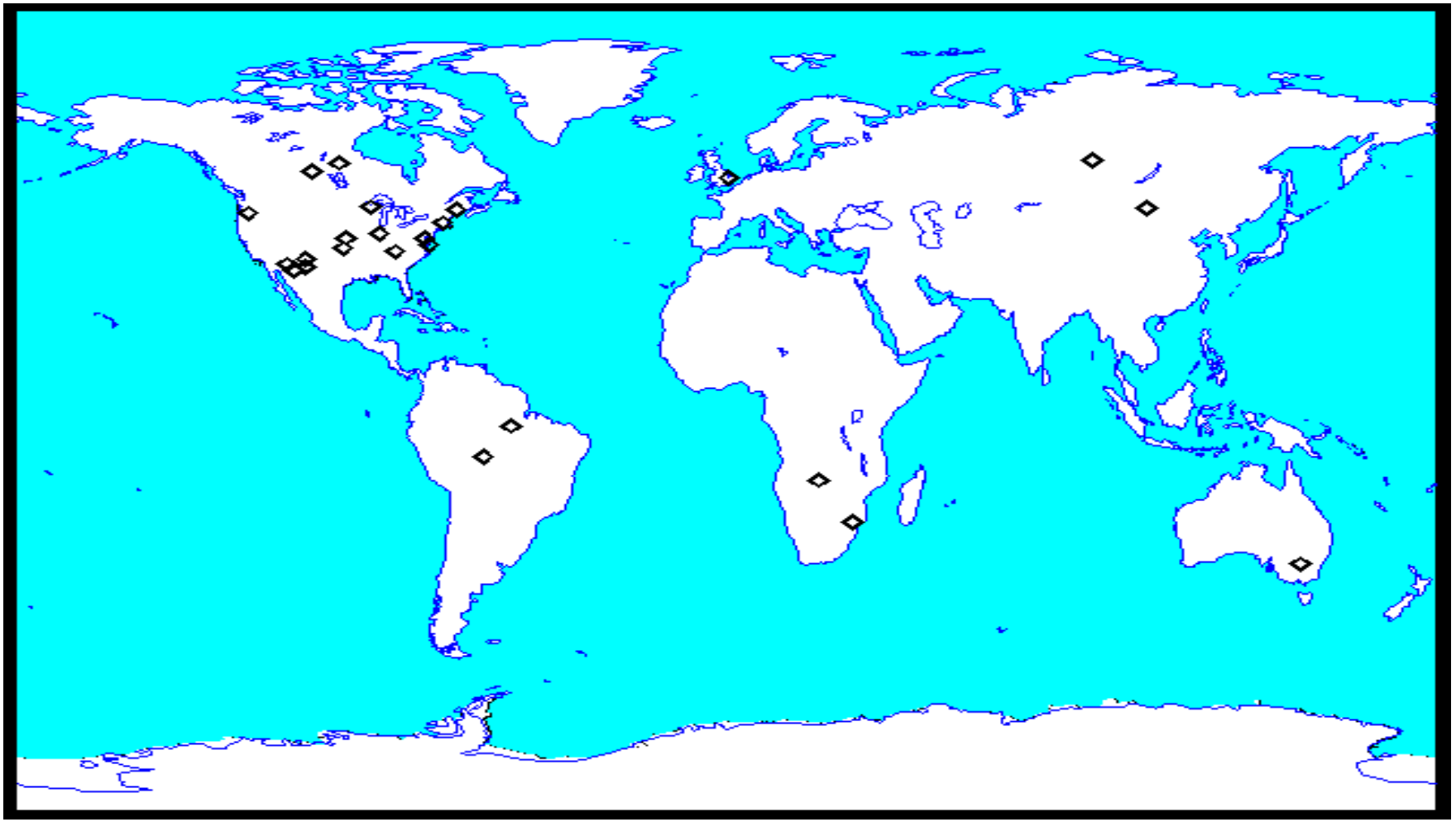
- **Biome type**
  - **Productivity**
  - **Global spatial extent**
- **Accessibility**
- **Existing facilities**

  (e.g. towers, laboratories, instrumentation)
- **Heritage/long term commitment**
- **North/South Hemisphere validation**
- **Homogeneous land cover (or "uniform heterogeneity")**

Core Sites by MODLAND Biomes:

Grassland / Cereal Crop	Shrubland / Woodland	Broadleaf Cropland	Broadleaf Forest	Needleleaf Forest
ARM/CART OK	Jornada LTER NM	BARC MD	Harvard Forest LTER	Boreas NSA Canada
Konza LTER KS	Mongu Zambia	Barton Bendish UK	Ji Parana Brazil	Boreas SSA Canada
Mandalgobi Mongolia	SALSA AZ & Mexico	Bondville IL	Tapajos Brazil	Cascades, OR (H.J. Andrews LTER)
Sevilletta LTER NM	Skukuza South Africa	Maricopa Ag. Center, AZ	Walker Branch TN	Howland ME
Uardry Australia		VA Coastal Reserve LTER		Krasnoyarsk Russia
				Wisconsin LTER

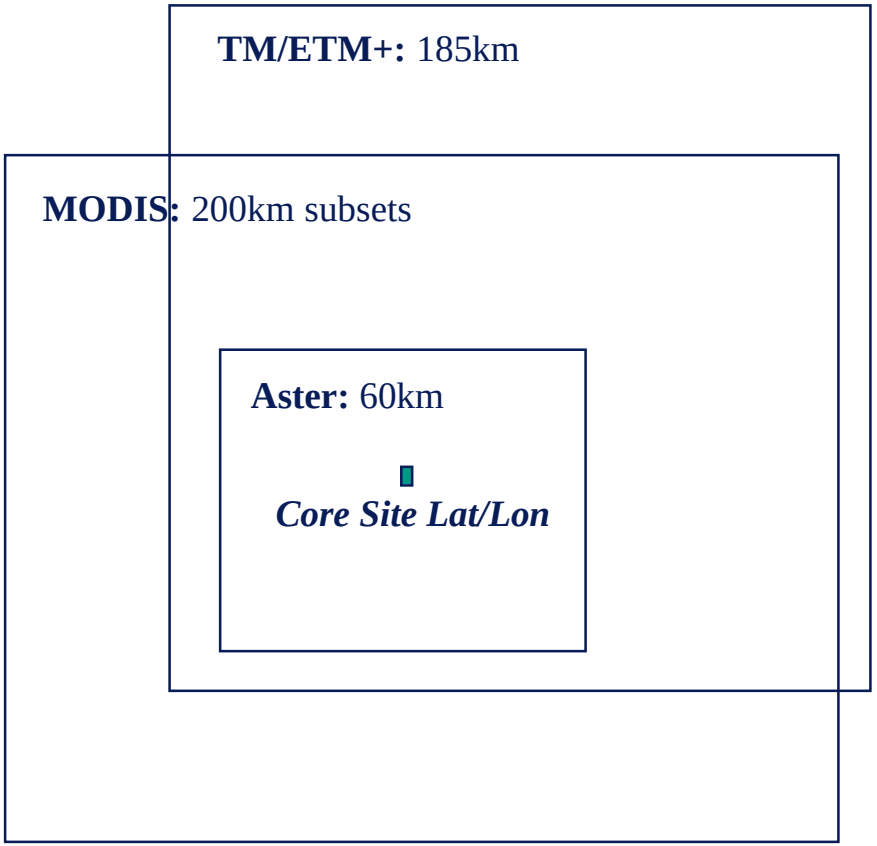
EOS Core Site Map



Core Site activities:

- **Characterize site properties**
- **Develop validation schedule**
- **Create individual web pages for validation data**
- **Help develop centralized web access and archive system for Core Site data**
- **Help develop acquisition plan for L7, ASTER and other EOS sensors data**
- **Develop MODIS subsetting capability**
- **Plan and acquire MQUALs and other Airborne data**
- **Ensure deployment of sunphotometers**
- **Negotiate access to historical data**

Data for EOS Land Validation Core site



Imagery expected at EDC:
- ASTER (60km)
- TM/ETM+ (185km)
- MODIS (subset)

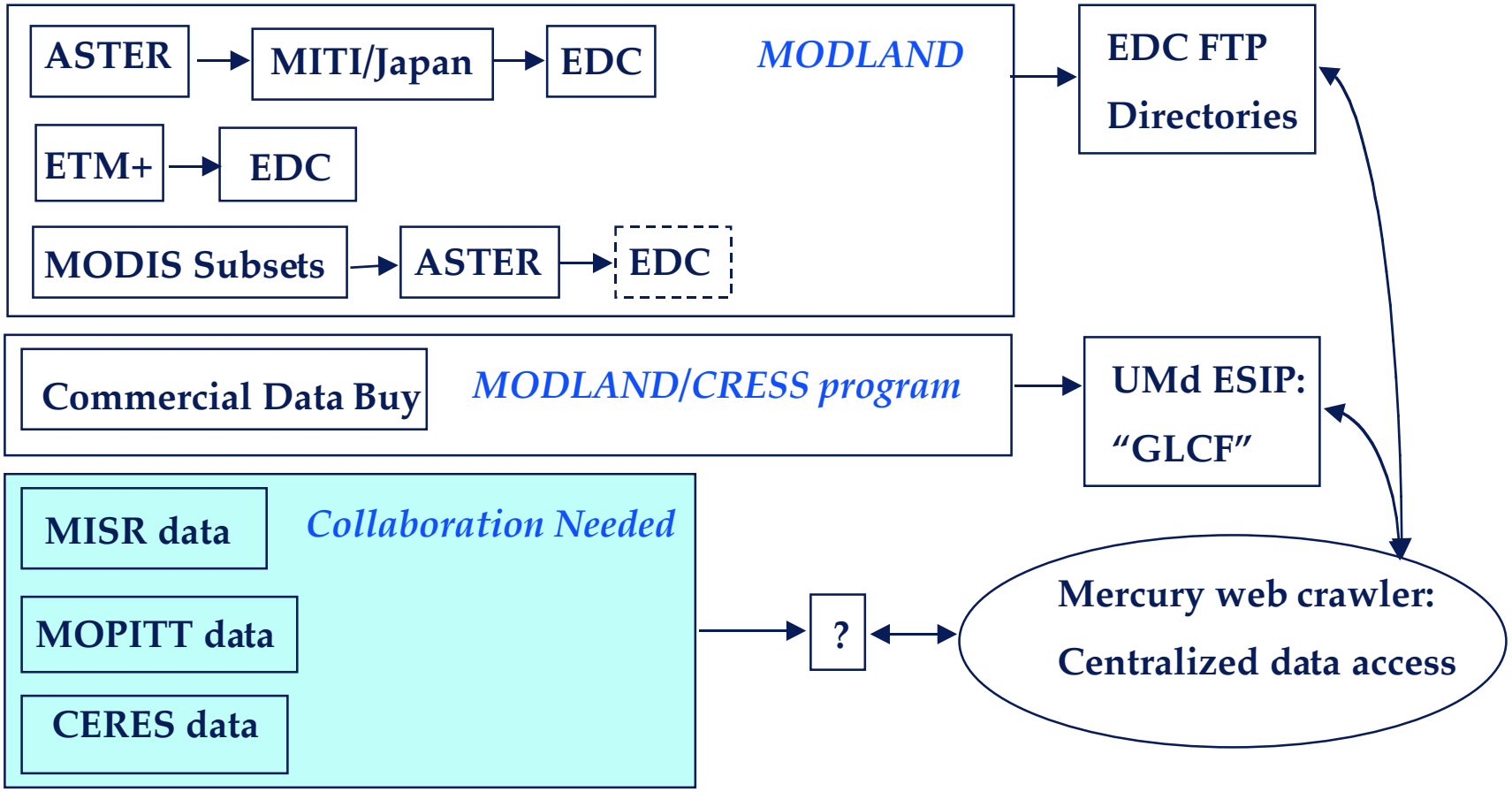
TBD:
- MISR (360km)
- CERES(subset)
- MOPITT (subset)

Possible Other Satellite Data for comparison:
- SeaWiFS
- AVHRR 1km
- High Res. Commercial data products

Ancillary Data:
- DEMs
- Land Cover
- Soils

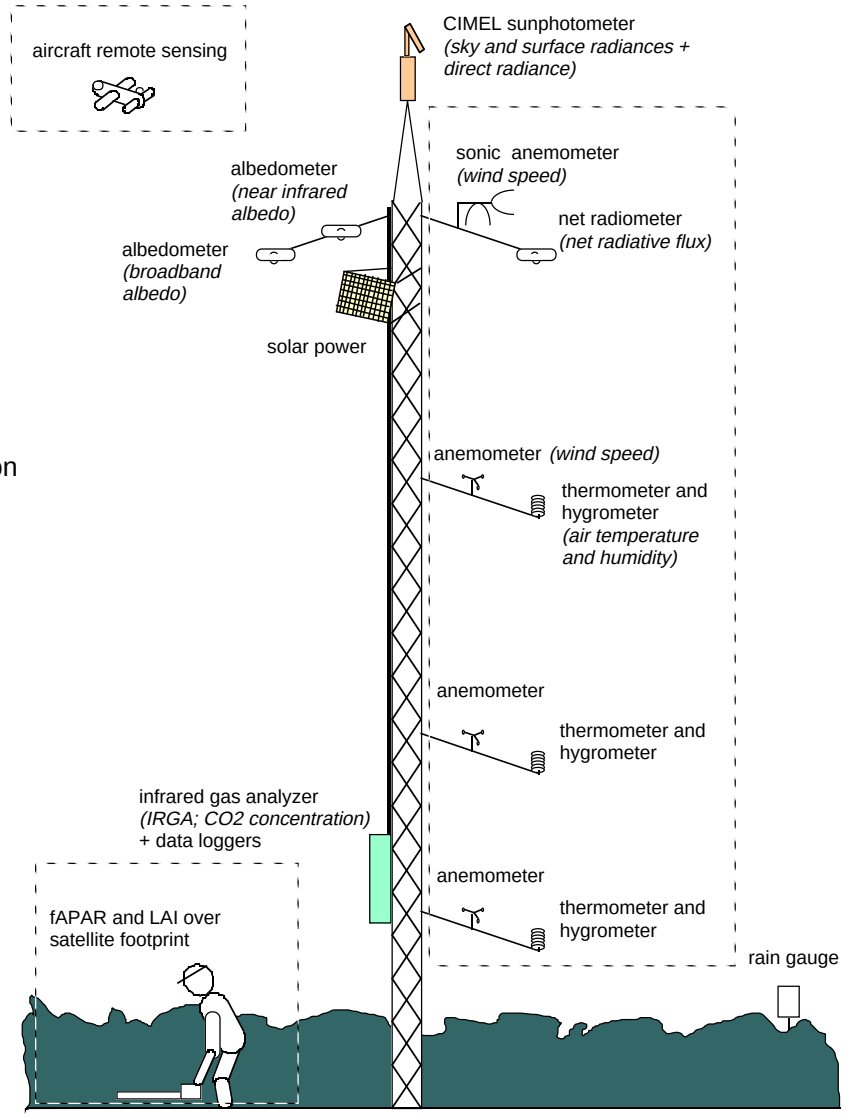
Field data:
through ORLN's Mercury

Core Site image data



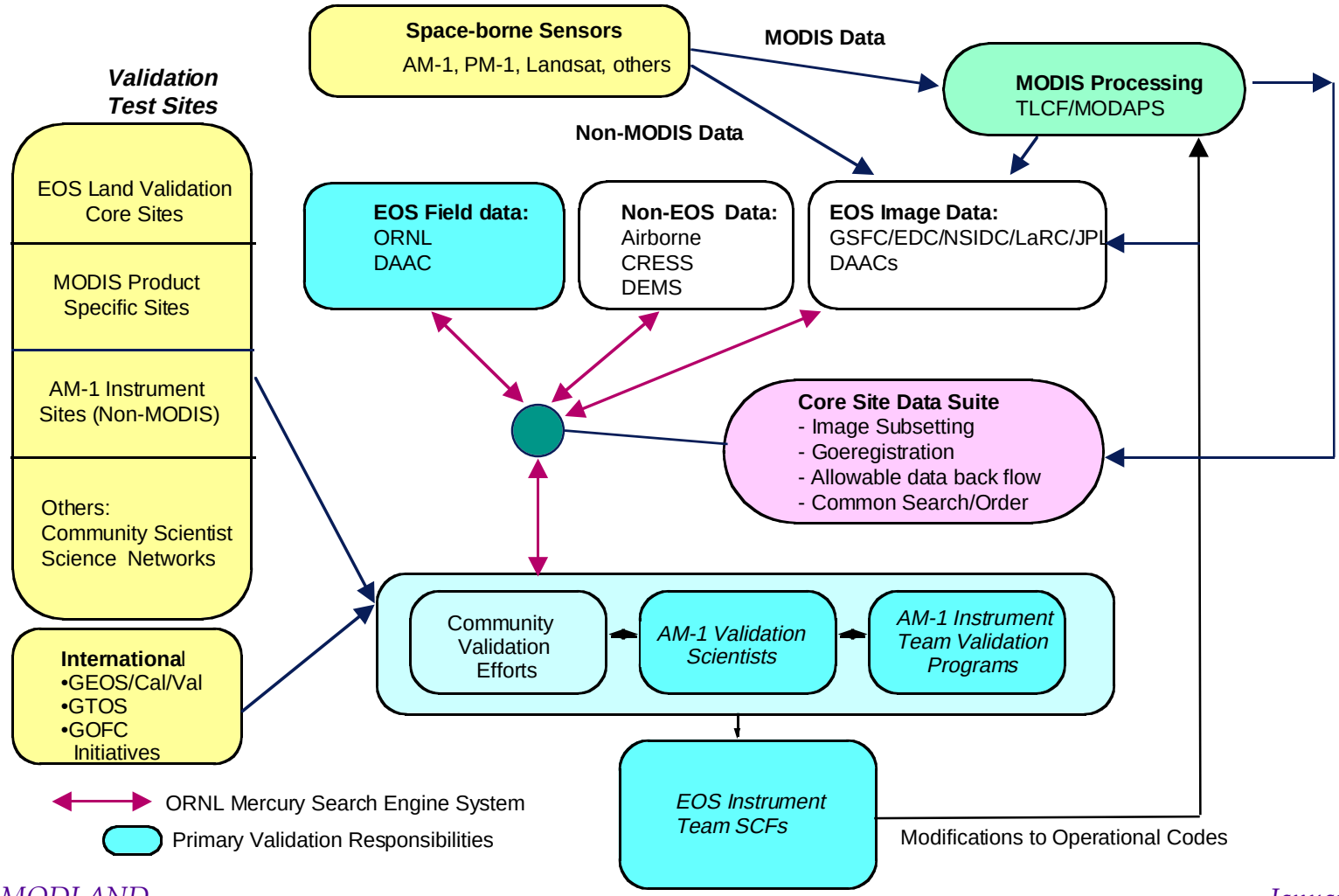
CRESS = Commercial Remote Sensing for Earth System Science

EOS Land Validation Core Site "Minimal Tower" Schematic



Indicates instruments in addition to those in "minimal tower" configuration

Data flow


Space-borne Sensors
AM-1, PM-1, Landsat, others
MODIS Data
MODIS Processing
TLCF/MODAPS
Non-MODIS Data
Validation Test Sites
EOS Land Validation Core Sites
MODIS Product Specific Sites
AM-1 Instrument Sites (Non-MODIS)
Others:
Community Scientist
Science Networks
EOS Field data:
ORNL
DAAC
Non-EOS Data:
Airborne
CRESS
DEMS
EOS Image Data:
GSFC/EDC/NSIDC/LaRC/JPL
DAACs
Core Site Data Suite
- Image Subsetting
- Goeregistration
- Allowable data back flow
- Common Search/Order
International
•GEOS/Cal/Val
•GTOS
•GOFC
Initiatives
Community Validation Efforts
AM-1 Validation Scientists
AM-1 Instrument Team Validation Programs
EOS Instrument Team SCFs
Modifications to Operational Codes
ORNL Mercury Search Engine System
Primary Validation Responsibilities

Product Specific Sites: Land Surface Temperature (MODIS and ASTER)

Amburla, NT, Austrialia
Broome, Australia
Death Valley, NV, USA
Dunhuang Gansu, China
Gobi Desert, China
La Crau, France
Lake Tahoe, CA, USA
Mammoth Lakes, CA, USA
Mauna Loa, HA, USA
Nam Co (Lake), Tibet
Park Falls, WI, USA *
Qinghai Lake, Qinghai, China
Railroad Valley, NV, USA
Safawi, Jordan
Salton Sea, CA, USA
San Luis Obispo, CA, USA
Tsukuba, Japan
Uardry Sheep Farm, Australia *
Uyuni Salt Flats, Bolivia

*** EOS Land Validation Core sites**

Product Specific Sites: Snow and Sea Ice

ARM/Barrow, AK, USA
Central Alaska, USA
Cordillera Blanca, S. America
Cordillera Real, Bolivia
Glacier National Park, MT, USA
Greenland AWS: Various Sites
Juneau Icefields, USA
Keene, NH, USA
Lake Mendota, WI, USA
Malaspina Glacier
Mammoth Mt, CA, USA
N.W. Minnesota, USA
Nevado Sajama, S. America
Niwot Ridge, CO, USA
Ross Sea, Antarctica
Vatnojokull and Hofsjokull, Iceland

MODLAND Validation Web Links

- **MODLAND Validation**
  http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL
- **Land Cover at BU: Validation and Test Sites (VATS - STEP)**
  http://crs-www.bu.edu/~jcfh/step.html
- **Land Cover Change at UMD**
  http://www.geog.umd.edu/landcover/modis/MOD44_valplan.pdf
- **LAI/FPAR/NPP Protocol**
  http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL/lai_meeting.html
- **LAI/FPAR/NPP Validation activity at BU**
  http://cybele.bu.edu/research/modismisr/validation.html

Cooperation with EOS Validation Investigators

14 EOS Validation Investigations evaluating MODLAND Products

- Baldocchi
- Fowler
- Gower
- Hook
- Li
- Liang
- Meyer
- Nolin
- Olson
- Privette
- Schowengerdt
- Shi
- Teillet
- Thome
- Ward

http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL/am1/abstract.html

Collaborations with Science Networks

- **AERONET** *http://aeronet.gsfc.nasa.gov:8080/*

  CIMEL Sun Photometers, several with BRDF capability. Currently being redeployed around validation network.

- **Fluxnet** *http://daacl.esd.ornl.gov/FLUXNET/*

  Global Array of Tower Flux Networks. Used in part to validate EOS Terrestrial Carbon, Water and Energy Budgets

- **BIGFOOT** *http://www.fsl.orst.edu/spacers/bigfoot/plan.html*

  Scaling and NPP studies at 4 Land Validation Core sites

- **IGBP** *http://rsrunt.geog.ucsb.edu/igbp.html*

  Land Cover Validation Activity

- **Global Land Cover Test Sites** *http://glcts.maxey.dri.edu/glcts/*

  Archiving of AVHRR and Landsat imagery for 9 of 23 EOS Land Validation Core sites

- **LTER** *http://www.lternet.edu/*

  Ongoing field and remote sensing measurements, 7 of 23 EOS Land Validation Core Sites

MODIS-led Pre-Launch Field Campaigns

- **Alaska - 1995**
- **CALWEST (Land Surface Temperature)**
  http://www.icess.ucsb.edu:80/~wan/modis_projects.html
- **Grassland PROVE - Jornada**
  http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL/prove/grass/prove.html
- **Forest PROVE - Walker Branch**
  http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL/prove/forest/prove.html
- **WINCE (Snow)**
  http://cimss.ssec.wisc.edu/wince/wince.html
- **Maricopa**
  http://gaia.fcr.arizona.edu/MARICOP.html

MODIS-Participation Pre-Launch Field Campaigns

- **BOREAS**
  http://boreas/BOREAS/BOREAS_Home.html
- **HAPEX Sahel**
  http://www.orstom.fr/hapex/
- **MONSOON**
- **OTTER**
  http://www-eosdis.ornl.gov/daacpages/otter.html
- **SAFARI '92**
- **SCAR - A, B, C**
  http://ltpsun.gsfc.nasa.gov/MAS

Field Campaigns - Planned

MODIS-led Field work

(with MODIS Team Member)

- **East Anglia, UK (Muller)**
- **Snow And Ice Measurements for MODIS (SAIMM) (Hall)**
- **Mongolia (Huete)**
- **CALWEST (Wan)**
- **Tibet (Wan)**
- **Mongolia (Huete)**
- **Railroad Playa (Huete)**
- **SAFARI 2000 (Justice/Swap)**

MODIS-participation Field work

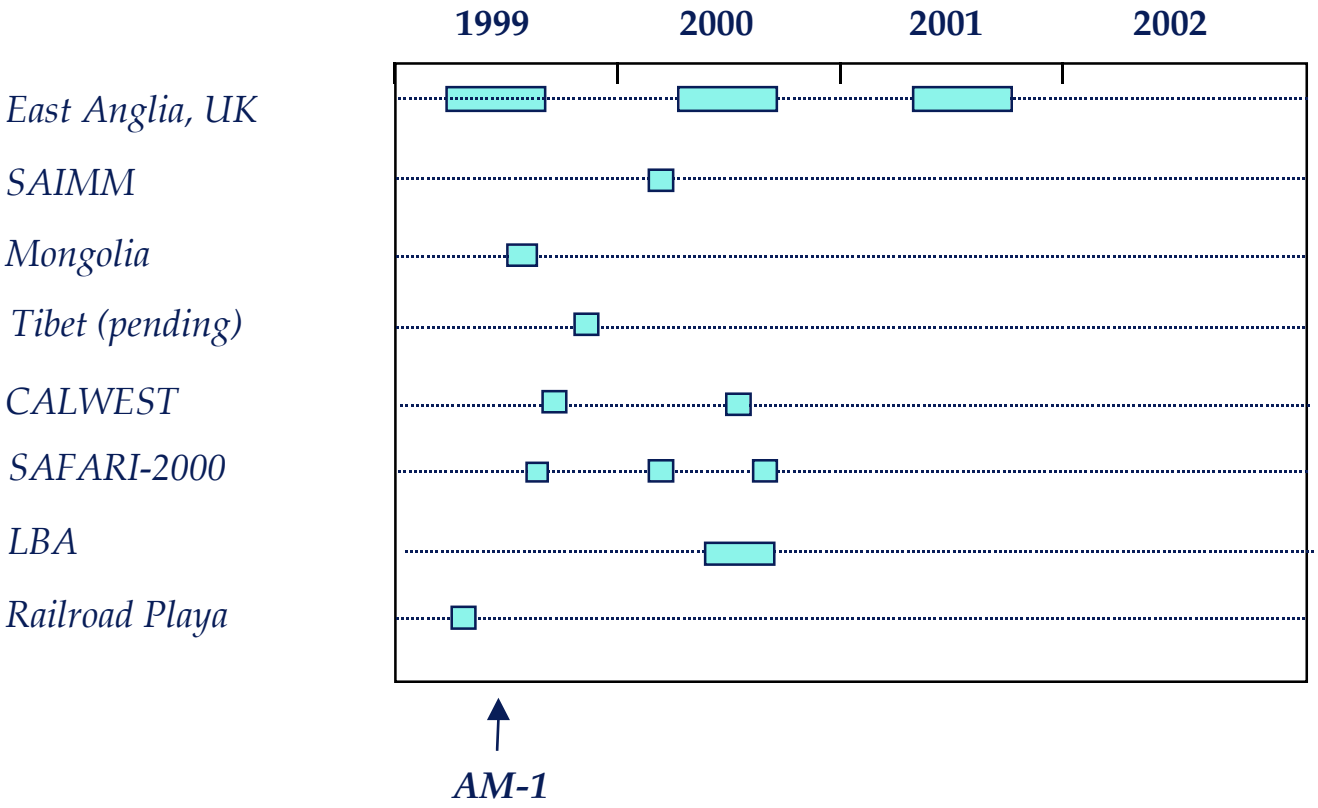
- **BIBEX (Through IGBP)**
- **LBA, Brazil**

http://www.cptec.inpe.br/lba/

- **SAFARI 2000**

http://safari.gecp.virginia.edu/

Currently Planned MODIS-related Campaigns



Schedule assumes a summer 1999 launch of AM-1

Developmental Activities

- **MQUALs** *http://gaia.fcr.arizona.edu/MQUALS.html*

  "MODIS Quick Airborne Looks" airborne radiometric system for rapid and low cost product validation. Multispectral digital camera, albedometer, 4-band radiometer, and GPS. Will use light aircraft operators local to each site.

- **CIMEL with BRDF**

  Modified sun photometer, reconfigured to collect directional surface radiances as required for validation of atm. correction, vegetation indices, and BRDF.

MQUALS initial site priorities

Top priority:

ARM/CART

Cascades/HJA

Bondville *

Harvard Forest *

Konza *

Maricopa

Wisconsin, Park Falls

Second priority:

BARC

Jornada

Walker Branch

International Sites

BOREAS NSA *

LBA

SAVE/SAFARI-2000

*** = Bigfoot site**

Priority based on field work activity planned for 1999, potential network interest, and multiple MODLAND products and EOS investigators utilizing the site.